

CAMPAGNE DE RECRUTEMENT 2007

PROPOSITION EN VUE DU RECRUTEMENT D'UN POST-DOCTORANT  
SUR SUBVENTION

**Projet de recherche :** CLIME

**Thème :** NUMC

**Titre du sujet proposé :** Assimilation of satellite data for air quality forecast

**Environnement :**

In the context of an ESA-EUMETSAT research project, the Clime team opens a post-doctoral position at INRIA-Rocquencourt. The candidate will carry out her/his works at INRIA, in co-operation with the CEREALaboratory of ENPC, specialized in atmospheric environment (the Clime team is a common research group with INRIA and CEREAL).

**Sujet de recherche** (4000 caractères max.) :

The MetOp satellite, launched in October 2006, carries two sensors (IASI and GOME2), providing measurements of the chemical composition of the troposphere: trace gases columns and profiles, aerosol optical properties. The quality of the measures is unprecedented, and atmospheric sounding are significant down to the first kilometres of the troposphere. The availability of these data opens a new perspective for the applications of satellite data: the improvement of the air quality forecast. The main objective of this post-doctoral position is investigate whether satellite data, which are representative of the upper layers of the troposphere (from 5 to 15km) can improve the forecast of pollutants' concentrations in the lowest layers (the atmospheric boundary layer). This work will be both experimental, by carrying out numerical experiments at real operational scale and by validating against effective observation data, and theoretical.

The key technique that will be used to ingest satellite data within the forecasting system is data assimilation, a technique that can be formulated as an optimality problem of the complex system constituted by models, observations, and climatologies. Clime has developed the Polyphemus platform, an air quality modelling system operationally used for ozone forecast at European scale. Polyphemus is capable of data assimilation, and will be the experimental platform used for this research.

The objectives of this post-doctoral position are:

- To demonstrate the feasibility of assimilating MetOp data for air quality forecast by leading data assimilation experiments in a real operational framework.
- To assess the improvement of air quality forecast, if any, due to the use of satellite data.
- To tackle theoretical issues related to the assimilation of satellite chemical and aerosols measurements.

**Présentation du projet de recherche et nom de l'encadrant :**

The proposed subject has experimental and theoretical aspects.

From the experimental point of view, the candidate will have to carry out data assimilation experiments in a real operational framework. This implies developing codes, to be inserted within Polyphemus. These codes will concern components of the data assimilation system: management of satellite observations, observation operators, error assessment, etc. This implies developing according to the specifications of a large system, and optimizing development for allowing computing in an operational framework, characterized by an important amount of data.

From the theoretical point of view, the candidate will have to tackle two open issues of satellite data assimilation. The first issue is the modelling of observation errors. The challenge here is to address the impact of the uneven vertical distribution of measurements errors: the satellite observations are more accurate in the upper parts of the troposphere than in the lowest parts, and the quality of the lowest measures is dependent upon temperature at the ground level. The second issue is the assimilation of aerosol data: aerosols are pollutants whose impact on health and climate is very important, but aerosols are hard to model and effective aerosol forecast faces a lack of observation data for all the parameters included in aerosols models. MetOp provides aerosols optical properties. The candidate will have to survey aerosol models to specify how to assimilate optical properties in these models.

The candidate will be supervised by Isabelle Herlin, head of the CLIME team. He/she will have to cooperate with other researchers of the team (at INRIA or ENPC), specialized in either satellite data processing, data assimilation, ozone forecast.

**Compétences et profil :** *(formation et spécialité(s), connaissance ou maîtrise d'outils, de techniques, de méthodes et de matériels spécifiques, .....*)

The candidate must be trained in applied mathematics, especially control and minimization. She/he must be able to program contributions to a large system, written in C++ (high level applications), Fortran (numerical code) and Python (post-processing and visualization).